Geometry of Quantum Entanglement

January 9, 2012, 9:00 – January 13, 2012, 12:30

The workshop will explore in more depth the connections between Quantum computation/information and high dimensional convex geometric analysis. Already, there have been a number of results that show the potential of such interactions and we want to continue the successful dialogue by organizing a workshop at CIRM.

The main objects of study in quantum information theory are *states* and *channels*. For every particular physical system, the corresponding states and channels form convex sets. A systematic analysis of these sets via conventional geometric, analytic and numerical methods is generally feasible only for very small systems: if one works with more than just a few qubits or qudits, our sets "live" in a space of a rather high dimension. Therefore one gets into the realm of *asymptotic geometric analysis,* which deals exactly with quantitative study of such high-dimensional objects and phenomena by identifying and exploiting "approximate" symmetries of various problems that escaped the earlier "too qualitative" or "too rigid" methods. While classically analyzing high-dimensional phenomena often suffers from the *curse of dimensionality* (the complexity of the problem exploding with the increase in dimension so that the question quickly ceases to be tractable), we may say that asymptotic geometric analysis exploits the *blessing of dimensionality*, with the symmetries mentioned above becoming apparent only when the dimension is large. Our plan is to facilitate a systematic exploitation of this unique perspective, which up to now appeared in quantum information theory only on an ad hoc basis.

This workshop will bring together researchers working in areas connected to quantum information theory and quantum computing and to asymptotic geometric analysis with the goal to intensify interaction between the different groups and to form new collaborations and future research across the various fields. In particular, as we want to invite a number of graduate students and postdocs, the workshop wants to give an opportunity for young researchers to interact with people from diverse areas and to build new connections.